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lpaw23@tecnico.ulisboa.pt

Reproducibility of wakefield amplitude from a plasma light diagnostic

J. Pucek[1], M. Bergamaschi[1], T. Nechaeva[1], L. Ranc[1], L. Verra[2], G. Zevi Della Porta[2] and P. Muggli[1], (AWAKE Collaboration)

[1] *Max-Planck-Institute for Physics, Munich, Germany,*
[2] *CERN, Geneva, Switzerland*

jan.pucek@cern.ch

Measurement of wakefield amplitude is possible through different diagnostics. Most measurements of the wakefield amplitude are complex. At AWAKE [1, 2], we have adopted a simple diagnostic [3] measuring emitted light from the plasma. Before recombining, plasma electrons sustaining the wakefields collide with surrounding atoms thereby dissipating the energy of the wakefields. Some of this energy is emitted as plasma light. Integrating the plasma light signal yields the wakefield amplitude at specific longitudinal position along the plasma.

We used this plasma light diagnostic to measure the amplitude of the wakefields as a function of different experimental parameters (proton bunch population, plasma density). We have demonstrated that when self-modulation (SM) is seeded (i.e. SM is reproducible) the variation in timing of microbunches along the bunch train is much smaller than when not seeded (i.e. SM is an instability) [4, 5]. We used this diagnostic to show that seeding also reduces the variations in amplitude of the wakefield i.e. the amplitude is reproducible. This diagnostic will be used to optimize the amplitude of the wakefields along the plasma for example when using a plasma density step [6]. We will present the experimental setup as well as most recent preliminary results.

References

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